

Name: _____ Manley KEY _____

Period: _____ ALL _____

Practice Problems

1. Determine the number of moles in each of the following:

632g $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$ 294g H_3PO_4 990g HCl

$$\frac{632 \text{ g } \text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2}{158 \text{ g } \text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2} = 4.0 \text{ mol } \text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$$

$$\frac{294 \text{ g } \text{H}_3\text{PO}_4}{98 \text{ g } \text{H}_3\text{PO}_4} = 3.0 \text{ mol } \text{H}_3\text{PO}_4$$

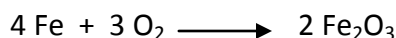
$$\frac{990 \text{ g } \text{HCl}}{36.5 \text{ g } \text{HCl}} = 27.1 \text{ mol } \text{HCl}$$

2. Calculate the mass of
- NaOH
- is needed to react with 196g of
- H_3PO_4
- in order to produce water and sodium phosphate according to the following reaction:



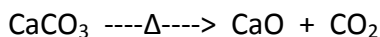
$$196 \text{ g } \text{H}_3\text{PO}_4 \times \frac{1 \text{ mol } \text{H}_3\text{PO}_4}{98 \text{ g } \text{H}_3\text{PO}_4} \times \frac{3 \text{ mol } \text{NaOH}}{1 \text{ mol } \text{H}_3\text{PO}_4} \times \frac{40 \text{ g } \text{NaOH}}{1 \text{ mol } \text{NaOH}} = 240 \text{ g } \text{NaOH}$$

3. Calculate the mass of
- O_2
- that is needed to react with 112g
- Fe
- to make iron (III) oxide?



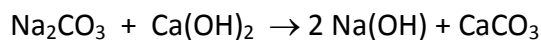
$$112 \text{ g } \text{Fe} \times \frac{1 \text{ mol } \text{Fe}}{56 \text{ g } \text{Fe}} \times \frac{3 \text{ mol } \text{O}_2}{4 \text{ mol } \text{Fe}} \times \frac{32 \text{ g } \text{O}_2}{1 \text{ mol } \text{O}_2} = 48 \text{ g } \text{O}_2$$

4. Calcium carbonate,
- CaCO_3
- , decomposes and produces 2.26g calcium oxide,
- CaO
- . If the theoretical yield is 2.68g, what is the percent yield?



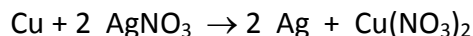
$$\% \text{ yield} = \frac{2.26 \text{ g } \text{CaO}}{2.68 \text{ g } \text{CaO}} \times 100\% = 84.33\%$$

5. Calculate the mass of CaCO_3 produced when 254 grams of Na_2CO_3 are reacted according to the following reaction:



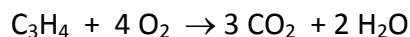
$$254 \text{ g Na}_2\text{CO}_3 \times \frac{1 \text{ mol Na}_2\text{CO}_3}{106 \text{ g Fe}} \times \frac{1 \text{ mol CaCO}_3}{1 \text{ mol Na}_2\text{CO}_3} \times \frac{100 \text{ g CaCO}_3}{1 \text{ mol CaCO}_3} = 239.6 \text{ g CaCO}_3$$

6. Calculate the mass of Cu needed to produce 2.25 g Ag according to the following reaction:



$$2.25 \text{ g Ag} \times \frac{1 \text{ mol Ag}}{108 \text{ g Ag}} \times \frac{1 \text{ mol Cu}}{2 \text{ mol Ag}} \times \frac{63.5 \text{ g Cu}}{1 \text{ mol Cu}} = 0.67 \text{ g Cu}$$

7. Calculate the volume of oxygen gas needed to produce 6.5 Liters of CO_2 according to the following reaction:

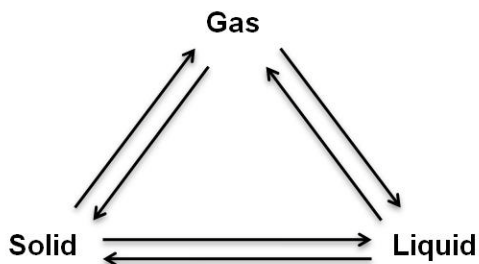


$$6.5 \text{ L CO}_2 \times \frac{1 \text{ mol CO}_2}{22.4 \text{ L CO}_2} \times \frac{4 \text{ mol O}_2}{3 \text{ mol CO}_2} \times \frac{22.4 \text{ L O}_2}{1 \text{ mol O}_2} = 8.7 \text{ L O}_2$$

Complete the following table

	Solid	Liquid	gas
Definite volume?	Yes	Yes	No
Fluid?	No	Yes	Yes
Compressible?	No	No	Yes (very)
IMF's	Strong	Medium	slight
Speed of particles	Very slow	Faster	Very fast

8. Label the following diagram:



9. What does the term dynamic equilibrium mean? Which system is at dynamic equilibrium – a closed water bottle or an open one?

See notes on page 3

10. Water boils at 100 °C while methane (CH₄) boils at -161 °C. Both have similar masses. Explain using KMT, specifically intermolecular forces, why water boils at a higher temperature.

Intermolecular forces specifically H-bonding.

11. Where will water boil at a higher temperature – Mount Everest or New Orleans? Explain. Lower atmospheric pressure on Mt Everest will cause lower vapor pressure and a lower boiling point than New Orleans

12. How are the Kelvin temperature scale and kinetic energy related?

KE is directly related to the Kelvin temperature

13. What are STP conditions?

See page 1 under gas properties

14. The initial temperature of a gas is 43°C. Calculate the final temperature if the volume changes from 500mL to 350mL at constant pressure?

$$\frac{(1)(500 \text{ mL})}{316 \text{ K}} = \frac{(1)(350 \text{ mL})}{x \text{ K}} = 221 \text{ K}$$

15. Calculate the original volume of a gas at -10°C if the final volume of gas is 200 gallons at 25°C and pressure is held constant?

$$\frac{(1)(x \text{ gal})}{263 \text{ K}} = \frac{(1)(200 \text{ gal})}{298 \text{ K}} = 176.5 \text{ gal}$$

16. Calculate the final pressure on a balloon if its volume changes from 250 ft³ at 770 mm Hg to 1000 ft³ with constant temperature?

$$\frac{(770 \text{ mm Hg})(250 \text{ ft}^3)}{1} = \frac{(x \text{ mm Hg})(1000 \text{ ft}^3)}{1} = 192.5 \text{ mm Hg}$$

17. A rigid vessel of gas at STP is heated to 900°C. Calculate the new pressure.

$$\frac{(1 \text{ atm})(1)}{273 \text{ K}} = \frac{(x \text{ atm})(1)}{1173 \text{ K}} = 4.3 \text{ atm}$$

18. Underline the solvent in each of the following solutions

- a. A solution containing 10.0 g of glucose (C₆H₁₂O₆) and 500.0 g of water
- b. A solution containing 60.0 mL of ethyl alcohol and 30.0 mL of methyl alcohol
- c. 5 quarts of water and 1 quart of antifreeze
- d. 5% sodium hypochlorite and 95% water
- e. 2% milk fat and 98 % water

19. Complete the following table using the combined gas law:

Parameter	Initial	Final
Temperature	23°C	58°C
Volume	360mL	150mL
Pressure	230 torr	?
Temperature	Standard	105°C
Volume	5L	?
Pressure	Standard	2 atm
Temperature	30°C	Standard
Volume	300mL	?
Pressure	795 mm Hg	Standard

20. Why does water not dissolve motor oil?

Simple, water is a polar solvent and oil is Nonpolar liquid.

21. In which solution is the solubility of a gas higher – cold water or hot water?

Cold water

22. What three things can you do to get sugar to dissolve faster in water?

- Stir the substances involved
- Heat the solvent and solute
- Grind the solid into finer particles

23. When a solute is added to water, what happens to the freezing point? To the boiling point?

The fp will lower and the bp will increase

24. Which will freeze at a lower temperature – a 1.5 m solution of NaCl or a 1.5 m solution of MgCl_2 ?

The MgCl_2 because this compound will produce more ions in solution

25. Which will boil at a higher temperature – a 1.5 m solution of $\text{C}_6\text{H}_{12}\text{O}_6$ or a 1.5 m solution of NaCl?

The NaCl because it is an electrolyte and produces more particles of solute in water

26. Calculate the molarity of a solution if 236g of HI is dissolved in 17,500mL of solution?

$$M = \frac{\left(\frac{236\text{g}}{128\text{g}} \right)}{17.50\text{L}} = 0.0105 \text{ M}$$

27. Determine the mass of solute in 2000mL of a 0.25M solution of CuSO_4 .

$$0.25\text{M} = \frac{\left(\frac{x \text{ g}}{149.5\text{g}} \right)}{2.0 \text{ L}} = 74.75 \text{ g}$$

28. Calculate the molarity of 114g $\text{Al}_2(\text{SO}_4)_3$ in 1500mL of solution.

$$M = \frac{\left(\frac{114 \text{ g}}{342 \text{ g}} \right)}{1.50\text{L}} = 0.22 \text{ M}$$

29. Calculate the weight of KBr needed to make 200g of a 5% solution.

$$5.00\% = \frac{x \text{ g KBr}}{200 \text{ g solution}} \times 100\% = 10.0 \text{ g KBr}$$

30. Calculate the mass of solute is needed to make 350mL of a 0.1M solution of C₂H₅OH.

$$0.1 \text{ M} = \frac{\left(\frac{x \text{ g}}{46 \text{ g}} \right)}{0.35 \text{ L}} = 1.61 \text{ g}$$

31. Calculate the molality of a solution in which 115g AlCl₃ in 1500g water.

$$m = \frac{\left(\frac{115 \text{ g}}{133.5 \text{ g}} \right)}{1.5 \text{ kg}} = 0.57 \text{ m}$$

32. What would be the freezing point and boiling point of the solution in #18

$$\Delta T_b = (0.57 \text{ m}) \frac{1.86 \text{ C}^\circ}{1m} (4) = 4.24 \text{ C}^\circ \quad fp_{new} = 0.0^\circ \text{C} - 4.24 = -4.24^\circ \text{C}$$

33. Calculate the pH and pOH of the following solutions:

0.00001M HNO₃

$$-\text{Log}_{10} [0.00001] = 5.00$$

$$14.00 - 5.00 = 9.00 \text{ pOH}$$

0.001M KOH

$$-\text{Log}_{10} [0.001] = 3.00$$

$$14.00 - 3.00 = 11.00 \text{ pH}$$

.00002M HCl

$$-\text{Log}_{10} [0.00002] = 4.70$$

$$14.00 - 4.70 = 9.30 \text{ pOH}$$

0.00254M HCl

$$-\text{Log}_{10} [0.00254] = 2.59$$

$$14.00 - 2.59 = 11.41 \text{ pOH}$$

0.0035M H₂SO₄ (0.0070 H⁺)

$$-\text{Log}_{10} [0.0070] = 2.15$$

$$14.00 - 2.15 = 11.85 \text{ pOH}$$

0.00044M H₂SO₄ (0.00088 H⁺)

$$-\text{Log}_{10} [0.00088] = 3.05$$

$$14.00 - 3.05 = 10.95 \text{ pOH}$$

34. Calculate the pOH, hydronium ion, and hydroxide ion concentration for a solution with a pH of 5 and a solution with a pH of 12.35.

$$14.00 - 5.00 = 9.00 \text{ pOH} \quad [\text{H}^+] = 10^{-5.00} = 1.00 \times 10^{-5} \text{ M} \quad [\text{OH}^{-1}] = 10^{-9.00} = 1.00 \times 10^{-9} \text{ M}$$

$$14.00 - 12.35 = 1.65 \text{ pOH} \quad [\text{H}^+] = 10^{-12.35} = 4.47 \times 10^{-13} \text{ M} \quad [\text{OH}^{-1}] = 10^{-1.65} = 2.24 \times 10^{-2} \text{ M}$$

35. Identify the conjugate base for the following:

- a. HCl Cl^{-1}
- b. H_2SO_4 HSO_4^{-1} and SO_4^{-2}
- c. H_2O OH^{-1}

36. Identify the conjugate acid for the following

- a. NO_3^{-} HNO_3
- b. NH_3 NH_4^{+1}
- c. $\text{H}_2\text{PO}_4^{-}$ H_3PO_4
- d. H_2O H_3O^{+}

37. Label the acid, base, conjugate acid and conjugate base for the following:

- a. $\text{HCN}_{(aq)} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^{+}_{(aq)} + \text{CN}^{-}_{(aq)}$
Acid base acid base
- b. $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^{+} + \text{OH}^{-}$
Base acid acid base

38. During a titration process, 35mL of 2.0M H_2SO_4 neutralizes exactly 20.0mL of NaOH.

- a. Calculate molarity of the base solution.

$$(2 \text{ H}^{+})(35 \text{ mL})(2.0 \text{ M}) = (1 \text{ OH}^{-})(x \text{ M})(20.0 \text{ mL})$$

39. If 15.2 mL of a 1.7 M NaOH solution are needed to neutralize 22 mL of HCl, what is the molarity of the HCl?

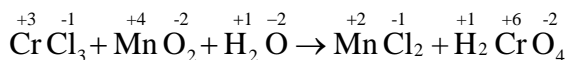
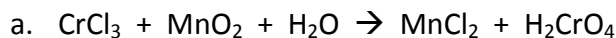
$$(1 \text{ H}^{+})(22 \text{ mL})(x \text{ M}) = (1 \text{ OH}^{-})(1.7 \text{ M})(15.2 \text{ mL})$$

40. How can you identify an Arrhenius (Traditional) acid from its formula? An Arrhenius base?

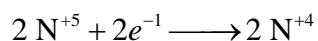
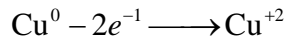
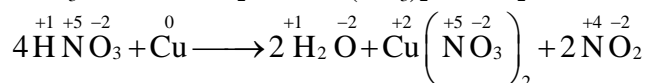
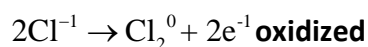
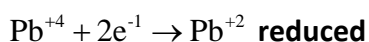
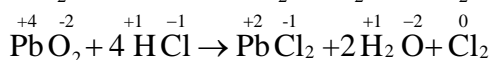
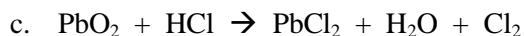
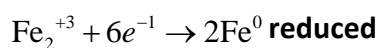
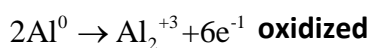
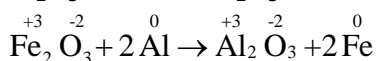
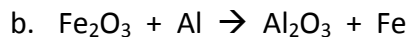
Formula starts with a "H" for acids and "OH" for bases.

41. For the following equations:

- Assign oxidation numbers to all atoms
- Identify which element is oxidized and which is reduced



Mn is **reduced** and Cr is **oxidized**



42. Use the solubility curve chart to answer the following:

- How many grams of $\text{Ce}_2(\text{SO}_4)_3$ will dissolve in 100 g H_2O at 10°C ?
About 15 g
- How many grams of NaNO_3 will dissolve in 100 g H_2O at 60°C ?
About 123 g
- How many grams of NH_3 will dissolve in 100 g H_2O at 90°C ?
About 7 g
- Identify the following solutions as saturated, unsaturated or supersaturated:
 - A solution of KClO_3 at 40°C contains 45 g in 100 g H_2O .
Supersaturated
 - A solution of NH_4Cl at 40°C contains 45 g in 100 g H_2O .
saturated
 - A solution of KNO_3 at 40°C contains 45 g in 100 g H_2O .
unsaturated

- e. How many grams of KNO_3 can be added to 100 g of H_2O if the temperature is increased from 0°C to 60°C ?

$$100 \text{ g KNO}_3 - 14 \text{ g KNO}_3 = 86 \text{ g KNO}_3$$

- f. How many grams of KCl will precipitate out of 100 g of water that is cooled from 80°C to 20°C ?

$$50 \text{ g KCl} - 32 \text{ g KCl} = 18 \text{ g KCl}$$

